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AMERICAN METEOROLOGICAL JOURNAL.

A Monthly Review of Meteorology, Medical Climatology, and Geography.

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AMERICAN METEOROLOGICAL JOURNAL.

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DEVOTED TO SCIENTIFIC METEOROLOGY AND ALLIED BRANCHES OF STUDY.

THE AMERICAN METEOROLOGICAL JOURNAL CO., Publishers and Proprietors,
Ann Arbor, Michigan.

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The editors solicit communications on all subjects having any bearing on Meteorology, Climatology, or American Geography. Correspondence on events of current interest is invited, and accounts of local newspapers concerning them will be welcome. Notes on local climate will be published and the columns of the JOURNAL are freely open for worthy communications on all matters within its scope. The editors do not hold themselves responsible for any communications which may be signed or attributed to other authorship than their own. Address all communications to

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Ann Arbor, Mich.

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VOL. IV. ANN ARBOR, NOVEMBER, 1887. NO. 7.

CURRENT NOTES.

CHANGES IN THE OHIO METEOROLOGICAL BUREAU.—Professor E. H. Mark, who has been secretary since August, 1883, has resigned, to accept the position of Professor of Physics in the Louisville High School. Mr. Charles M. Strong, of the Signal Service, has been detailed by the Chief Signal Officer to perform the duties of this office.

FORESTRY IN EUROPE.—The State Department publishes with this title an octavo pamphlet of 320 pages, with an index, which makes a valuable contribution to this subject. It includes the reports of consuls in various parts of Europe, made in reply to a series of well-chosen questions sent out by the department last November. The reports from Germany are the most complete, and after them follow Austria, France, Italy, and Switzerland.

ABOVE-GROUND TORNADOES.—A vital point of M. Faye's theory of tornadoes is that they originate in the cloud-layer of the atmosphere, and this makes all aerial tornadoes of especial interest. One of this character passed over Clarion township, near Charlotte, N. C., on the afternoon of September 28, 1887. It tore through the clouds like a big balloon, dipping down and rising again, carrying an eddying mass of fence-rails and tree-limbs in its circling path. It looked like a big black funnel, and whirled around like a huge top. It was about one hun-

dred feet above the surface of the earth, but would occasionally dip down, wrench off the tree-tops, and sweep up fences. The cyclone traveled at the rate of thirty-five miles an hour, and made a tremendous roar. It dipped down on the plantation of Mr. Alexander, tore up a number of peach and apple trees, took away the roof of his house, and, rising again, disappeared in the direction of Philadelphia church. The skies were overcast with heavy clouds, among which a visible commotion was made as the big, black, funnel-shaped mass tore its way around them.

"SCIENCE."—We have not noted the successive changes in the weekly journal, *Science*. They have all been in the direction of making it appeal to a larger circle of readers, and any intelligent person of scientific tastes should now find it interesting reading. By the same publisher is issued the *Swiss Cross*, a bright and interesting monthly, the organ of the Agassiz Association, and edited by Mr. H. H. Ballard, the president of the association. It appeals to young readers, and deserves a good support.

THE USE OF OIL AT SEA.—Admiral Cloué, of the French navy, has determined by observation that a layer of oil only $\frac{1}{20000}$ of a millimetre in thickness is sufficient to prevent waves from breaking. This is only a two-millionth of an inch, and it would take only five gallons of oil to still the breaking of the waves over a square mile. A ship needs to have the waves prevented from breaking only for a small space to the windward, and, properly applied, only a small fraction of a pint ought to do this. All the officers of the French navy are under instructions to study the best means of applying the oil.

THE CHILIAN CENTRAL METEOROLOGICAL OFFICE, in part 5, of volume 18, of its annual, publishes the observations for September and October, 1886. The stations number twenty-two and run in latitude from Iquique (S. 20° 12′) to the Light House on Punta Arenas (S. 53° 10′). In longitude they are on a nearly

north and south line varying only from 70° to 74°. Eight of the stations are light-houses and several are schools. The most elevated station is the Liceo of San Felipe, situated 657 metres above sea-level. The observations are taken at 7:30 A. M., 1:30 P. M., and 9 P. M., except on the 8th, 18th, and 28th of each month, when they are taken every three hours.

THE ROYAL OBSERVATORY AT PALERMO.—The third volume of its publications, just received, contains much of interest to meteorologists. Professor Zona has an article on the sirocco of August 29, 1885, with references to the origin of the fœhn. About 400 pages of the volume are occupied with meteorological observations taken in the years 1881, 1882, and 1883. We may note that in the same volume are some fine colored drawings of the planet Jupiter made by the well-known student of this planet, Professor Riccò.

STATE AID FOR FOREST CULTURE.—While the friends of forest culture are pressing the national legislature for aid in their excellent undertaking, it is well to remember that the individual states can do much. Dakota, where timber-culture is especially desirable, has made very liberal provisions for its encouragement. Chapter 145 of the session laws of 1885 provides that any person planting one acre or more of prairie land, within five years after the passage of this act, with any kind of trees except black locust or cotton-wood, and successfully growing and cultivating for three years, shall be entitled to receive for ten years thereafter an annual bounty of $2 for each acre so planted and cultivated, to be paid out of the territorial treasury, but such bounty shall not be paid any longer than such trees are maintained and kept in growing condition. The code further provides that any one-fourth part of any quarter section of prairie land, the same being a legal sub-division, on which five acres of timber shall be planted by either sowing seed or by setting trees or cuttings, and the same to be kept in growing order by cultivation, and not to be more than twelve feet apart each way, together with all improvements thereon not to exceed in value

$1,000, shall be exempt from taxation for a period of ten years from and after the planting of said timber, and any change of ownership of such land shall in no way affect the exemption from taxation as herein provided. To secure the benefit of this exemption, the applicant shall file an affidavit with the assessor that he has in every way complied with the requirements of the law, whereupon the assessor shall therein state in effect the following words, to wit: "Exempt from taxation by virtue of tree culture," and shall describe the particular tract or tracts of land so exempt.

A SIGNAL SERVICE IMPROVEMENT.—According to a press dispatch from Washington, the importance of early and successful forecasts of the weather is greatest, perhaps, in the Northwest. In order to meet the needs of that section of country, and comply with the earnest application from citizens and corporations of great vested values, the chief signal officer has decided to station an indication officer at St. Paul, Minn. This arrangement will enable that officer to receive his reports an hour earlier than in Washington, and will further enable him to send out warnings of cold waves in that section from two to five hours earlier than is now done. A warning earlier by two or three hours, while not of special importance east of the Mississippi river, is, however, to the country of the northwest, where the earliest signs of a cold wave are rarely more than twelve to sixteen hours in advance of its full predominance. The stationing of an officer in the northwest, who can make predictions for five or six states for the winter and spring months, will also relieve, to a considerable extent, the overtaxed indications officer of the central office. This arrangement went into effect several weeks ago.

DR. CIRO FERRARI'S WORK.—We have before us three thick quarto volumes, one for each year, for 1885, 1886 and 1887, and all the work of one man. They are Dr. Ferrari's studies on the thunder-storms of Italy. His work has been frequently noticed in this journal and some of it carefully reviewed, and we are led

to this note rather by its magnitude when it is seen all together. It seems hardly possible that one man could manage to do so much in the short interval of three years.

The last volume, published this year, and to which we have not referred before, gives the results of his studies of the thunder-storms of 1882 and 1883. It is accompanied by thirty-five beautiful illustrative charts.

Thunder-storms have received a great deal of attention since this journal began its existence three and a half years ago. Our knowledge of the subject stands now on an entirely different footing from that on which it stood then. To these additions to our knowledge the American students have contributed not a little. Professor Hazen, of the Signal Service, has devoted much time to them and has accumulated an immense amount of material. We may hope that when his results see the light in their finished form they may prove quite as important a contribution to the subject as any that has gone before.

California Weather.—Sergeant Barwick, Observer in the Signal Corps and Meteorologist of the State Board of Agriculture, has published a second annual meteorological review of the State of California, which, like the preceding, contains a very large amount of valuable information. It is a pamphlet of 167 octavo pages, with many illustrations and charts, and is apparently published by the Board of Agriculture as a state document. Some of the matter included in it has already appeared or been reviewed in these pages, but much of it is new to us. The pamphlet is the review for 1886, but the data are often continued to 1887.

Pages 8 to 40 are occupied with a detailed and valuable review of the weather of Sacramento, by Mr. S. H. Gerrish. Mr. Hugh D. Vail gives the statistics of the climate of Santa Barbara, and Mr. Hiram Arents reviews the climate of Oroville. The rainfall statistics are continued by Mr. H. E. Wilkinson. Dr. Trembley gives the results of his year's observations at Oakland. There are many other things of interest in the pamphlet, but they are too numerous to specify. The pamphlet is a valuable

addition to our knowledge of the climate of California. We have no doubt but that our readers can get it by application to Sergeant Barwick at Sacramento.

THE NORTHERN MEXICAN STATES seem to be having their full portion of natural casualties recently. The earthquake of last spring was a very severe one, and lately cloud-bursts and hurricanes seem to be unusually frequent. On the night of October 10, the Chubiscar river was suddenly flooded to so great an extent that the iron railway bridge just below Chihuahua was carried away. The bridge was forty-two feet high and two hundred feet long. It was strongly constructed and was supposed to be invulnerable, but a cloud-burst just above the city sent a torrent down the river channel that swept the bridge away like a feather.

At about the same time a very severe storm swept over the coast of Sonora and Sinaloa. The storm was accompanied with very high water, and Mazatlan and San Blas were very seriously injured. The storm was the most severe ever remembered in that region.

The Mexican States adjoining our boundaries are very similar to the territories next to them. Sonora is a second Arizona, becoming damper towards its southern end, while Chihuahua is much like New Mexico. Southern California is, it seems, a much better country than has been thought. The Mexican government has farmed out its northern moiety to an enterprising company of capitalists, and, if their circulars are trustworthy, it is a second Eden. We have no doubt that its capacities are really much greater than they have been represented.

DRAINAGE BY WHOLESALE.—It has become a usual plan of speculators to attempt to drain large areas in order to add to and sell the additional farming lands. Recently it was announced the Georgia's Okeefeenokee swamp was to be drained for this purpose, and now comes a similar, though not so extensive enterprise from Wisconsin. The town of Norway, in Racine county, has taken steps to institute an action under chapter 169

of the laws of 1887, providing for the drainage and reclamation of certain lands in Racine and Waukesha counties, to construct a system of drainage to lower the level of the water in Wind Lake. The object of the work is to drain some eight thousand acres of swamp and overflowed lands adjacent to the lake above mentioned. As a part of the plan, a canal will be constructed from Great Muskego Lake, in Waukesha county, southerly to Wind Lake in Racine county. The canal from Wind Lake will follow the general course of what is known as the "outlet," and will be eight miles in length from Wind Lake to Fox River, in the town of Rochester, where it will terminate.

The whole length of the canal will be about twelve miles, and it will drain somewhere in the neighborhood of fifteen thousand acres of land, now almost worthless, adjacent to the lakes mentioned. The canal proper is to be 30 feet wide at the top, 14 feet wide at the bottom, and 6 feet deep. The excavating will be done by steam dredges, commencing at the lake end of the proposed canal, in order to afford water to float the dredges. When completed, the improvement will have cost in the neighborhood of $75,000. Lands now under water will be converted into good farm lands, and an actual benefit of nearly $500,000, it is claimed, will result. This undertaking is perhaps the most extensive of its like ever undertaken in that State.

It would probably be better for the country at large if the extensive swamps could remain, for they serve as excellent reservoirs for the moisture in the air. The evaporation from a swamp is many times as great as from a lake of the same size, and the drainage of great swamps is probably more injurious than the destruction of forests. In general the great swamps should be left, especially in the western states.

High-Level Meteorology has proved to be very useful in the development of the science, and much enterprise has recently been shown in this direction by several of the weather services abroad. For this reason we regret to learn from our exchanges that the station on the top of Mt. Washington is about to be discontinued for at least a part of the year. Lieut. Woodruff is

quoted, in the *Electrical Review*, as saying: "It will be of interest to the public to know that the station on the top of Mount Washington is to be discontinued. It has been interesting to watch the atmospheric changes at that station, but they are of little or no practical benefit to the rest of the district. The altitude is so great that the changes there rarely affect the lower atmospheric strata. The wind might be blowing a hurricane at the summit of the mountain while a dead calm prevailed at the base. I suppose the station will be run in the summer season, say from May to September, inclusive, to accommodate summer visitors to the mountains, but it seems to be a needless expense to maintain it during the winter. It is a most uncomfortable place to spend the winter in, and I guess the operators won't regret leaving it during that part of the year. I suppose this action will surprise a good many people, but really when you come to think of it you will see that the reports from that station are read more as curiosities than as being of any practical benefit."

THE GENERAL BIBLIOGRAPHY OF METEOROLOGY.—Prof. Cleveland Abbe described at the recent meeting of the British Association for the Advancement of Science, as we learn from *Symons's Monthly Meteorological Magazine*, the steps which had been taken in the United States Signal Office in completion of the Meteorological Bibliography begun by himself and subsequently strengthened by the splendid work of Dr. Hellman and others, whereby finally about 52,000 books and pamphlets had been catalogued. He stated that the work was now practically complete and ready for publication, and awaited only the necessary funds for its printing to be undertaken. Mr. Buchan, Mr. Symons and others congratulated Prof. Abbe on the completion of this great labor, and a resolution expressing the hope that it would be printed as soon as possible was passed by the Section.

Subsequently a resolution was carried unanimously by the General Committee of the whole Association to the following effect: "That the Council be requested to take such steps as to

them shall seem expedient in order to communicate to the Signal Office the high importance attached by British Meteorologists to the Bibliography compiled by the Signal Office, and their hope that it may speedily be rendered accessible to all nations by being printed and circulated."

Observations in Russia. — The fourth supplement of the *Repertorium für Meteorologie*, published under the direction of Professor Wild by the Russian Royal Academy of Sciences, is a catalogue of meteorological observations in Russia and Finnland by Dr. Leyst.

"We find in the present work all meteorological stations of the Russian Empire and of Russian America, as well as some Russian stations in Persia, China and Japan. Russian observations in West Europe are omitted entirely."

Mr. Leyst gives the latitude, longitude, elevation above the sea level, and a short account of the observations made for each station, together with the names of the observers.

The observed elements were air pressure, temperature, humidity, direction and force of winds, amount and form of clouds, precipitation, hydrometry, optical, electrical and plant life phenomena, earth's temperature, radiation, evaporation, duration of sunshine, atmospheric electricity, rise and fall of rivers, etc. Of course at most of the stations only a small number of the just mentioned elements were observed.

The scope of the work includes the year 1882, but as the work was not printed as soon as prepared, many stations are brought down to the year 1885.

In European Russia 846 stations are given; in the Caucasian Region, 106; in Asia, 214; and in the Aleutian Islands and Alaska, 9. Although this array of figures impresses one with the idea that Russia is doing much for the advancement of meteorology, yet it is only by reading the description of some of the stations that we can obtain an idea of the mass of material already collected, and the magnitude of the work accomplished by Mr. Leyst. A great part of the observations being in manuscript, must have rendered the collection of data exceedingly

laborious. The care and research necessary may be well shown by the following: The early observations at St. Petersburg, beginning in 1725, had no place of observation assigned, and it was only by various notes entered into the record books by the observer at the time, that it was established that the record referred to St. Petersburg; such notes as "Ball to Her Serene Highness, Duchess of Holstein" appearing at intervals, and thus identifying the place.

The present work will be very useful in indicating the place where the results of observations of any particular place in Russia have been printed or where the original record is preserved. F. W.

RAIN-FALL OBSERVATIONS IN MICHIGAN.—The director of the Michigan Weather Service issues, under date of September 10, the following circular, to which we gladly give place:

The question of the amount of the annual rain-fall has become of such importance to the agricultural interests, that many farmers are keeping daily records of the amount of rain-fall.

The reports of this office published since February, 1887, show that there has been an average monthly deficiency of rain-fall, from March 1st to July 31st, of one inch, or over 5 inches for the entire period.

The importance of knowing how much rain has fallen will be realized when it is considered that one-tenth of an inch of rain-fall corresponds to a deposit of about 40 hogheads per acre, and of how much benefit a shower will be to the crops.

The rain-gauge should be in the hands of every famer in the State, so that the amount of rain-fall may be accurately determined for each locality.

The State Weather Service, to establish the annual precipitation for the State and to aid the farmers in ascertaining the rain-fall of their farms, makes the following propositions:

To each farmer who will purchase a rain-gauge, the Service will furnish all necessary blanks for recording the amount of rain-fall, the time of commencement and ending of rain-storms, and will publish each report furnished this office in the Monthly Weather Review, where it can be easily consulted for comparison.

The rain-gauges will be furnished for $1.25, the exact cost at the manufactory in New York. The gauge consists of a copper funnel 1½ inches deep and three inches in diameter, and this funnel sits in a brass tube or reservoir, one inch in diameter and ten inches long. The whole

is inclosed in a galvanized iron overflow receiver. The gauges are strong and can not be easily injured.

The time occupied in taking an observation is very small, and consists in ascertaining the amount of rain-fall collected in the gauge by means of the measuring stick, which accompanies each gauge, and recording it, with the time of beginning and ending of the rain or snow on the forms furnished free by this office. The observation can be taken at any regular hour, daily, preferably at 2 P. M., and will not take ten minutes' time.

The value of knowing the monthly and annual rain-fall of any locality in the State, for agricultural purposes, is too well known by the farmers to enlarge on this subject now, and the Michigan Weather Service places this matter before the farmers of Michigan, in the belief that the mutual benefits to be derived will cause each farmer to obtain a gauge at the earliest date.

Every report adds to the value of this work, and farmers can readily compare reports of rain-fall of their own locality.

The Service would be pleased to have fifteen hundred gauges in the hands of farmers by the first day of November, when the winter season fairly begins.

All blanks and instructions will be furnished by this office.

If you do not desire to take up this matter, please hand this to some farmer who is interested. N. B. CONGER, U. S. A., Director.

LAKES MICHIGAN AND HURON.—A curious question arose at the recent convention for the improvement of the Illinois river, held at Peoria in October. It is proposed to cut through the low water-shed between Chicago and the Illinois, and have a navigable canal connecting the St. Lawrence and Mississippi. The divide southwest of Chicago is only ten feet above the mean level of Lake Michigan, the engineers tell us, and the geologists add that the outlet of the lake once formed a broad river in this direction, which river was filled by detritus in the glacial age and has never been reopened since. The new canal would open this outlet, and the fall is so considerable that the difficulties will lie in not permitting the current to become too strong.

The question, which has been raised for the first time, apparently by Major Handbury, is, would not the canal so far decrease the outflow through the St. Clair river, and lower the level of the lakes, as to interfere with navigation on the St. Clair

and in the harbors in use at present? The average discharge through the St. Clair is estimated to be 217,000 cubic feet per second. It is proposed to make the discharge through the new canal equal 10,000 cubic feet per second.

The question is not so quixotic as some of the Chicago papers say in their editorials. The surface area of lakes Michigan and Huron, including Georgian Bay, is estimated by Schermerhorn, in his recent article in the *American Journal of Science*, at 46,-250 square miles. A depth of an inch of water over this entire surface is equivalent only to 0.7 of a cubic mile of water. But a discharge of 10,000 cubic feet per second would convey away a cubic mile of water in less than six months, or 0.7 of a cubic mile in about four months. If the new canal were the only discharge of the lakes in question, and there were no additions to them, the new canal would lower the level about an inch in three months. In the next three months the lowering would be less because the discharge would be less, and so on until the level of the lakes was that of the bottom of the canal.

The problem is not much complicated by the discharge already existing. The discharge through the St. Clair is enough to keep the lakes at a nearly, not absolutely, uniform level. The level varies with the season. On the average its variation is 1.3 feet, the lowest water being in late autumn and early winter. But this variation is so small that we may consider the St. Clair as just discharging the surplus water of the upper lakes. The new canal would, in this case, by lowering the level, decrease the discharge through the St. Clair, and the lowering of the level would proceed much more slowly. The data for computing the amount of this are not at hand, but it is safe to say that with a very slight lowering, less than three inches, a new position of equilibrium would be reached in which the canal would carry off a very small percentage of the former discharge of the St. Clair.

Subsidence of Fine Solid Particles in Liquids.—A very interesting and suggestive paper by Dr. Carl Barus, on this subject, has recently been published. We call attention only to some features which are suggestive from a meteorological point

of view; although the facts found for subsidence in liquids are by no means necessarily true for gases, they suggest that similar phenomena may be looked for in the latter.

Mr. Barus found that after a powder had been thoroughly shaken up in water and then allowed to stand, if its fall were slow, the subsiding powder was sure to show one or more distinct horizontal planes, and these were so sharp that they could be used in observing the rate of subsidence. The surfaces of fog-banks and clouds are often very sharply defined, more sharply than can be easily caused by the differences of temperature and humidity—the principle used to explain them at present. An analogous phenomenon may have occurred in the subsidence of the Krakatoa dust. Observers, again and again, called attention to an apparent layering.

Mr. Barus finds that the velocity of fall of the particles increases very rapidly with the increase of temperature. The subsidence of fine earthy dust in distilled water is enormously more rapid at the temperature of 100° C. than at 0°. This fact suggests numerous meteorological applications. He also finds that the use of a very small per cent. of common salt accelerates the subsidence of particles in water to a remarkable degree. The increased temperature and the addition of salt seem to increase the activity of the jostling multitude of molecules and to enable the subsiding particles to force them aside and thread its way between them with much greater speed.

Farther knowledge leads us to give more and more weight to dust as a meteorological factor. Aitken has shown, and physicists now generally believe, that moisture is condensed from the air only on surfaces already present, and these surfaces are afforded by the particles of dust. The long series of phenomena which followed the eruption of Krakatoa were, as is now proven, dust phenomena. More recently it has been shown that dust has peculiar relations to electric and magnetic action, and that many of the phenomena of finely comminuted solids are curiously like those of liquids. One curious investigator (we have not his name at hand) has shown that dust left to itself in a closed box for a series of years will spontaneously re-arrange

itself, and the originally level and uniform layer will have thrown itself into ridges and other more remarkable forms. There seems to be a science for such comminuted solids, and anything adding to that science should be especially welcome to meteorologists.

THE METEOROLOGICAL SERVICE OF THE DOMINION OF CANADA has an immense territory for its field, large parts of which are but very sparsely settled or not settled at all. In 1884, as we learn, from the report which has just reached us, Mr. Carpmael, the efficient director, had one station on Prince Edward's Island, two on Newfoundland, seven in British Columbia, ten in New Brunswick, fifteen in Nova Scotia, twenty-two in the Northwest Territories (from Calgary and Medicine Hat to Lesser Slave Lake and Hudson's Bay), twenty-three in Quebec, forty-one in Manitoba, and one hundred and forty-two in Ontario. Ontario takes the lead by far, due partly, no doubt, to the location of the central station in Toronto. But it is curious to note that the new and sparsely settled province of Manitoba comes next.

For Ontario the stations are so thickly scattered that Mr. Carpmael can publish seasonal and annual rain-fall charts, which are included in this volume. The annual map shows some interesting features. It seems from it that in this region as richly endowed with large and small lakes as any on the earth's surface, the rain-fall is very unequal and not very heavy. The heaviest rain-fall is forty-five inches, and is on three small regions, one just east, a second just west of the southern end of Georgian Bay, while the third is a small patch about Stratford, about midway between the west end of Lake Erie and the south end of Lake Huron. This patch fairly preserves its integrity on each of the seasonal maps. It seems to be a sort of rain-fall island, reminding one of the warm island of Michigan, discussed by Alexander, and the warm belt of the Alleghanies, discussed by Chickering. A study of the details of this island would doubtless well repay the local meteorologists.

The report also includes a rain-fall map for April, May and June, for a part of Manitoba.

The system of telegraphic weather reports and predictions is established and in working order. The director gives the following estimates of the verification of storm warnings for the years indicated:

Year.	Per cent. of Verifications.
1877	68.6
1878	78.3
1879	83.0
1880	82.8
1881	85.1
1882	78.2
1883	79.1
1884	83.1

The average of the number of storm warnings each year is about 800.

AN ARGENTINE STATE WEATHER SERVICE.—The following circular letter has been received from the Argentine Republic concerning the founding of a new meteorological service:

CORDOBA, (REP. ARG.), April, 1887.

I have the honor to bring to your notice that by a decree of March 29th the government of the province of Cordova has founded a meteorological service for its territory, which contains more than 3,000 square geographical leagues.

Without excluding other studies, the principal aim of the new service is the investigation of this climate, which will afford a quickening interest for science, as much by its location at the centre of the Argentine Republic as by the variety of its configurations.

The government having honored me by making me director, I beg you will accord your favors to the new institution, which, at the beginning of next year, will make its début with a quota of meteorological stations which form a net-work completely independent of the national series founded by Mr. Gould and carried on by Mr. Davis.

Notwithstanding this appointment, I shall continue, as in the past, in the position confided to me and which I now occupy.

Accept, my dear sir, my highest regards.

DR. OSCAR DOERING,
Professor of Physics, National University.
President of the National Academy of Sciences.

In explanation of this circular, the decree establishing the service and the plan of organization, together with the corre-

spondence relative to the work, have been brought together in a small pamphlet bearing the stamp "official edition." From this we gather that this new service will be similar to our own State Weather Services, and will consist of a central station, where the results will be collected, and which will undertake the verification and supplying of instruments to the other stations; 15 stations of the 2d order, 10 stations of the 3d order, and 15 stations of the 4th order.

The observations will be published in the "Annario Meteorolôgico de la Provincia," etc., of which 600 copies will be printed. F. W.

ANNUAL MEETING OF THE NEW ENGLAND METEOROLOGICAL SOCIETY.—The New England Meteorological Society held its fourth annual meeting recently at the Institute of Technology, Professor Niles in the chair. The following officers were chosen: W. H. Niles, of the Institute of Technology, president; Winslow Upton, of Brown University, secretary; Desmond Fitzgerald, of the American Society of Civil Engineers, treasurer. These, with Mr. W. M. Davis, of Harvard College, Mr. E. B. Weston, of the Society of Civil Engineers, and A. Lawrence Rotch, of Boston, constitute the council of the society.

Professor E. C. Pickering, of Harvard College Observatory, gave an account of the meteorological work which had been done during the present year in the interest of the observatory. In the establishment of an astronomical observatory in furtherance of the purposes of the Boyden bequest which came to the Harvard College institution, extensive meteorological investigations have been made during the past summer, and will be continued through the winter, in Colorado, which offers many accessible situations for an observatory of high altitude. The advantage of such high altitude is in a reduction of the density of the atmosphere by carrying the point of observation above the lower strata. But such advantage cannot be gained by locating an observatory in a mountainous region unless the atmospheric conditions of all kinds are favorable. The present

number of high stations where meteorological observations are made are but few. In Europe there are only two which exceed 3,000 metres in height, being about 10,000 and 11,000 feet respectively. Of those less than 3,000 metres and more than 2,000, there are nine in Europe and none in this country. Of those between 1,000 and 2,000 metres above the sea level, there are fifteen in Europe and sixteen of the National Signal Service in this country. But among the Signal Service stations there is one which is pre-eminent in the particular named, that of Pike's Peak, which has an altitude of 14,000 feet, exceeding thus by 3,000 feet and more any in Europe. These great heights are much more accessible on this continent than in Europe. There are five in America where 11,000 feet or more is reached by railroads built for facilitating mining work. The highest of these in North America is Mt. Lincoln, in Colorado, the mining works on which are 14,297 feet above the sea. Here a meteorological station has been established for the purposes of Harvard College Observatory, and is provided with self-recording instruments and placed in charge of competent persons.

Professor Winslow Upton, of Brown University, discussed the subject of meteorological observations during solar eclipses. It appeared in his statement that Mr. A. L. Rotch, of the Blue Hill, Mass., Meteorological Observatory, and himself had visited Russia during the present year for the observation of meteorological phenomena occurring during the total eclipse of the sun. He gave exclusive credit to Mr. Rotch for the equipment of the expedition with the best known apparatus, some of it having been constructed for this occasion. The prevalence of clouds during the entire period of eclipse prevented the accomplishment of the work most desirable to be done. But clouds could not utterly circumvent the meteorologists as they did the astronomers, and many interesting and instructive results were obtained.

A vote of thanks to the volunteer observers of thunder-storms and sea-breezes during the summer of 1887 was passed. —*Boston Transcript.*

PROFESSOR LOOMIS'S CONTRIBUTIONS TO METEOROLOGY.—In his ninth memoir, which has recently been published by the National Academy of Sciences, Professor Loomis gives some personal details which we are sure will interest our readers. We give these, including the entire preface:

"Fifty years ago, when a tutor in Yale College, I became greatly interested in Redfield's investigations respecting the laws of storms; and from that time to the present day I have never lost my interest in meteorological phenomena. In 1836 I was appointed professor of natural philosophy in Western Reserve College, and was sent to Europe to purchase instruments for my department. Among my purchases was a superior set of meteorological instruments, and on my settlement in Ohio I commenced a meteorological journal, embracing daily observations of the barometer, thermometer, etc., and I also made hourly observations for thirty-six hours at the equinoxes and solstices, according to the scheme proposed by Sir John Herschel. In October, 1837, a hurricane of considerable violence passed within five miles of Hudson, and I improved the opportunity to make a careful survey of its track, with special reference to deciding between the conflicting views of Redfield and Espy, but the materials for this purpose were not as complete as I had expected. In order to obtain fuller materials for this purpose I resolved to select some storm of unusuul violence and collect all the information possible respecting it, and to make a thorough examination of its phenomena. I selected the storm of December 20, 1836, and succeeded in obtaining a considerable mass of observations relating to it. The results of this investigation were published in the Transactions of the American Philosophical Society, and seemed to show that neither the views of Redfield nor Espy were wholly correct, and that much remained to be learned respecting the laws of our winter storms. I found it impossbile to obtain observations respecting the storm of December, 1836, which would enable me to make so complete an investigation as I desired, and I waited in the hope of being more successful with some future storm.

"In February, 1842, a tornado of unusual violence passed within 20 miles of Hudson. As soon as I received the news, I started out with chain and compass to make a thorough survey of the track, and succeeded to my entire satisfaction. As the tornado passed over a forest of heavy timber, I had the best opportunity to learn the direction of the wind from the prostrate trees; and by measuring the direction of the trees as they lay piled one upon another, I determined the successive changes in the direction of the wind. The facts demonstrated incontestably that the movement of the wind was spirally inward and upward, circulating from right to left about the center of the tornado.

This tornado was but an incident in a great storm which swept over the United States, and I resolved to collect all the information possible respecting the general storm. In this attempt I met with fair success, and in discussing the observations I adopted methods which are now familiar to all the world, but which were new to me, and which, so far as I know, had not at that time been employed by any other person. The results were published in the Transactions of the American Philosophical Society. This investigation showed conclusively that Redfield was mistaken in supposing that in all great storms the wind revolves in circles about the center; and also that Espy was mistaken in supposing that the air moves toward the center in the direction of radii.

"After completing this investigation, I desired to apply my new methods of research to another violent storm, but the labor and expense involved in collecting my materials induced me to wait, hoping that as the number of observers increased more abundant materials might be obtained, and with a less expenditure of time and money. In 1856, during a somewhat extended tour through Europe, I improved the opportunity to collect observations respecting a storm which prevailed in Europe soon after the American storm of December, 1836, and which some persons supposed to have been connected with the American storm. On my return to the United States these observations were carefully discussed and the results were published by the Smithsonian Institution.

"Years rolled on, and the favorable opportunity which I had looked for to enable me to resume my investigations of the phenomena of storms did not come. The Smithsonian Institution had indeed organized a large body of meteorological observers, but most of the observers had no barometer, and many of the barometers which were used were unreliable. At length the Signal Service was organized, and now came the opportunity for which I had been waiting thirty years, but had almost despaired of living to witness. As soon as I had obtained one daily weather map, for two years I commenced a careful examination of these maps, for the purpose of deducing from them general laws. As the observations multiplied, I was enabled to undertake the investigation of new questions, and the results are coutained in a series of papers published in the *American Journal of Science*, and entitled "Contributions to Meteorology." These papers have attracted considerable attention in Europe. The first nine papers were translated into French by M. Brocard, and were published in Paris by the late Abbé Moigno, under the title of Météorologie Dynamique. A very full abstract of several of these papers has been published in Italian by Dr. Ciro Ferrari, of the meteorological office at Rome, in a pamphlet of 92 pages, with numerous plates. Notices of most of the papers have from

time to time appeared in various scientific journals of Great Britain and the Continent of Europe.

"The subjects investigated in these contributions were taken up without any regard to systematic order, and the later results, having been derived from a much greater mass of materials, will sometimes be found not to harmonize entirely with the results published in my earlier papers. Under these circumstances it has been thought desirable to revise the entire series of papers, and reduce them to a more systematic form, improving the opportunity to combine new researches on points heretofore neglected, and to reduce all results from the entire series of observations now available, not only from the United States but from Europe and other parts of the world. The present memoir contains the first chapter of this revision, and it is designed that other chapters shall follow as rapidly as my strength will permit."

The lack of harmony, mentioned above, is not great. It is rather a growth of definiteness of view naturally resulting from the growth of the science since Professor Loomis's studies were begun. The matter of greatest interest in the memoir appears in the causes assigned to the occasional and exceptional progress westward of storm-centers of the United States. The author thinks "that the westerly movement of low centers, which is occasionally observed in the middle latitudes of Europe and America, is generally due to one or more of the following causes:

1. The influence of one low area upon an adjacent low area, which influence sometimes seems to act as an attractive force.

2. The influence of a considerable fall of rain or snow, which also acts as an attractive force.

3. The influence exerted by two areas of high pressure, not very remote from each other, by which means a new movement is imparted to the air included between them, and a new low center is sometime developed.

4. The influence of an area of high (or only moderately high) pressure, on the northeast side of a low area, when the gradients on the southwest side of the low area are slight, in which case the center of the low area may be crowded towards the south-west.

If these causes are sometimes sufficiently powerful to divert the center of a low area westward, it may be presumed that there are many more cases in which these causes are sufficiently powerful to affect, in an appreciable degree, both the direction and velocity of the movement of a low center."

THE RELATION BETWEEN GEOGRAPHICAL FORMS AND GEOLOGICAL FORMATIONS.

It is certainly useful for the student, in order that he may group his facts, and it may even prove interesting to the scientist, to trace the close connection throughout the globe, between the form assumed by land, when it shows itself above the ocean, and the geological formations which, on examination, we find characterizing these different geological structures.

In general terms, the first fact to which attention may be called, is that nearly all the back-bone elevations or mountain chains, of materials durable enough to have partially resisted disintegration and denudation, are prolonged into capes, peninsulas, promontories, etc.; and at least the nucleus of these is very generally formed by igneous eruptive material of various age, including granite, and sometimes by metamorphic rocks.

On the other hand, the great gulfs, bays, and many large inland seas are found generally in the proximity of later aqueous formations, being almost entirely surrounded by rocks of cenozoic age. The chief exception seems to be Hudson's Bay, of which, however, we have few accurate geological details.

The paper suggests another thought. Large islands and projecting angles characterize the eastern continental coast lines, while smaller islands and re-entering coast angles are more common on the west side. Thus Iceland is east of Greenland, Newfoundland of North America, Madagascar of Africa, Japan and Borneo of Asia, New Zealand of Australia; with such continental salient angles as Capes Charles, Frio, Guardafui and Ras el Had, East Cape, and many others, on the east. On the west we find the Aleutian, Queen Charlotte and Vanconver's Islands, in North America; the Gallapagos Islands and Chiloe, with a great re-entering angle in South America; also the Gulf of Guinea with Ascension, St. Helena, St. Thomas and others, in Africa; the Maldives and Laccadives west of Hindostan, the Andaman and Nicobar Islands west of Siam, in Asia.

I. EUROPE.

1. *European Capes, Peninsulas, Promontories, etc.*—Begin-

ning with Europe at its southwest Capes, in Spain and Portugal, we find the capes resulting from the extension of the Sierra Nevada, Asturias and intermediate ranges, all more or less permeated by granite rocks; and at Cape Ortegal, by trap. Granite is found at Napoleon Vendée and Brest in France, at Cornwall and the Scilly Islands in England; trap is met with from Wales to the northeast coast of Ireland and west of Scotland. Iceland is made up of ancient and modern volcanic rocks, Spitzbergen presents escarpments of granite; the Orkney and Shetland Islands owe their durability to gneiss and other metamorphic rocks. The Apennines are largely volcanic, and the mountains of Corsica and Sardinia exhibit both ancient and modern volcanic rocks, although no volcanoes.

2. *European Seas, Gulfs, Bays, etc.*—On the other hand, the basins of the Mediterranean and Black Sea are almost entirely Tertiary, with some Cretaceous; the Red Sea is largely surrounded by Tertiary, especially in north Egypt and Nubia, and the Tertiary of the Gulf of Gabes extends far into the Sahara. So also the Bay of Biscay, the Straits of Dover (London Clay over Chalk) and the south curve of the Baltic, from northern Denmark almost to the Gulf of Riga, cut into Tertiary.

II. ASIA.

1. *Asiatic Capes, Peninsulas, Promontories, etc.*—The Urals, projecting into the Arctic Ocean, have trap along their whole extension (Murchison); and north Cape and Cape Taimur present gneissoid rocks (Nordenskiold). Kamchatka has granite and porphyries with basalts, and later volcanic rocks, while trachyte and basalt characterize Japan. The predominating rock in Sumatra is trachyte with some granite, syenite and porphyry. In Java the formation is essentially trachytic with some diorites and porphyries; the western Ghauts consist of trap in the north and laterite in the south, forming Cape Comorin, (Ency. Brit.)

2. *Asiatic Seas, Gulfs, Bays, etc.*—The basins of the Caspian and Aral Seas, the Persian Gulf, Gulf of Cutch, Bay of Bengal, Gulfs of Tonquin, Sea of Japan, and part of Ockhotsk, will be

found, in a great measure, formed along Tertiary coasts, while the Pi-chi-li Gulf and Yellow Sea have vast deposits of loess, on their western border, in the Provinces of Chin-li, Shan-se, Keang-su, etc.

III. AFRICA.

1. *African Capes, Peninsulas, Promontories, etc.*—The rounded form of this continent presents fewer capes, etc., than we find in the others; but the Capes of Farina, Blanc and Bugeron, as well as at Algiers and Ceuta on the north, besides the Cape of Good Hope on the south, are made up chiefly of gneiss and other metamorphic rocks; Cape Guardafui is also crystalline (Boué).

2. *African Gulfs, Bays, etc.*—The great Gulf of Guinea is bounded on its north and east by Tertiary, which can be traced as continuing from Fernando Po, and Prince's Island to St. Thomas and St. Helena; such formation we also find in the Angola and Benguela Bays, as well as in Zanzibar and Mozambique.

IV. NORTH AMERICA.

1. *North American Capes, Peninsulas, Promontories, etc.*—The prevailing rocks in Labrador are gneiss (Sir W. Logan), terminating in Cape Charles. Associated with Carboniferous rocks, granites are found in Nova Scotia, and trap rocks overhang the coasts along the Bay of Fundy (Ency. Brit.). The crystalline rocks of the Appalachians run up into Maine, and those of the Sierras down into the Peninsula of California, in which are also volcanic rocks, ancient and modern. So, too, the Peninsula of Alaska and the Aleutian Islands are made up of volcanic rocks, as well as Yucatan and Guatemala.

2. *North American Gulfs, Bays, etc.*—All along the Atlantic sea-board of the United States, are fine bays, harbors, etc., formed by Tertiary surroundings; the great Gulf of Mexico has the Tertiary of Texas on the west, of Louisiana and Alabama on the north, of Florida on the east, and Yucatan on the south (Boué). Tertiary occurs also on the west coast of Mexico, forming part of the Gulf of California.

V. SOUTH AMERICA.

1. *Capes, Peninsulas and Promontories, etc., of South America.*—The immense back-bone of the Andes is largely made up of crystalline and eruptive rocks from Cape Horn to Venezuela; there being a considerable amount of metamorphic rocks in Venezuela and Bolivia, interspersed with long stretches, chiefly volcanic and apparently closely connected underneath, as Darwin * mentions that "on the night of January 19, 1835, the volcano of Osorno, in South Chili, became active; while, on the same night, Aconcagua, in Middle Chili, 480 miles north, broke out in a similar manner; then six hours later the V. Conseguina, which had been dormant 26 years, and which is 2,700 miles north of Aconcagua, burst forth with a violent eruption, accompanied by an earthquake felt over 1,000 miles;" and, again,† he says: "The Cordillera from Tierra del Fuego to Mexico, is penetrated by volcanic orifices; and those now in action are connected in great trains."

Further, we have Cape Parima in Ecuador, and the magnificent promontories at Cape Horn and Tierra del Fuego. On the east coast a submarine granitic ridge extends from Cape St. Roque to Cape Frio.

2. *Gulfs, Bays, etc., of South America.*—D'Orbigny found large areas of sub-apennine Tertiary (Pliocene) along the coast of Bolivia, where the great concave curve cuts into the west coast of South America. He says Tertiary also occurs on the east coast of South Brazil, at Uruguay, the mouth of the La Plata, and especially throughout Patagonia, into which the Gulfs of St. Matias and St. George cut. Tertiary is also found near the mouths of the Oronoco and Amazon.

The paper further shows the same generalization applied to Australia.

In conclusion, notice is called to the

Comparative Seismology

of the two classes of rocks. Several modern writers have pointed out the fact that *earthquakes prevail in Tertiary*

* Voy. of a Natur., Vol. II. page 31.
† Geol. Observer, page 602.

regions, mostly at the junction with older and harder formations.

To trace only some of the most prominent, we may remark, as being both Cenozoic and Seismic:

1. The Atlantic seaboard from East Haddam, Conn., through the intermediate States to near Charleston, S. C., and Tallahassee, Florida.

2. The Pacific Coast of the United States: California, Alaska and Aleutian Islands.

3. The West India Islands.

4. Considerable areas on the Pacific Coast of South America.

5. The basin of the Mediterranean, including parts of Greece and Asia Minor.

6. Iceland, the Azores, Canary and Cape Verd Islands.

7. Kamchatka and Japan.

8. Java and all the rest of the Malay Archipelago.

9. Central portions of New Zealand (Oligocene south of Cook's Straits).

R. OWEN.

NEW HARMONY, IND.

AIR PRESSURE IN A TORNADO.

In December, 1884, on page 339, this journal, there is a note by J. F. Llewellyn, on this question. In the last number, on page 240, there is another note by the same author, probably. It is hardly to be expected that this question will be satisfactorily settled for years to come, though there are indications of a gradual change of views. The writer of the notes, I think, has confused two things which should be kept most carefully distinct. In the article from which he quotes it is explicitly stated that tornadoes invariably occur to the southeast of a low pressure area. It is very plain, that as this low pressure advances, there will be a general fall in barometer readings, in all the region in its front and to some distance to right and left. This is the fall in pressure that Mr. Llewellyn alludes to, but it is admitted by the theorists that the low pressure area has very little to do with the tornado proper. At one time it is probable that the tornado was regarded as occurring at the center of the low pressure area (cyclone) where it was supposed that there

was a great uprush of air. When observations increased and the tornado was found 400 to 600 miles away from LOW it was necessary to assume an enormous and sudden fall in pressure at the tornado center; in fact, so sudden was this supposed to be and over so limited an area, that it could not be observed on an instrument. This certainly was a convenient assumption and might account for the lack of direct observation. The time has now come, however, when such hypotheses will not do, and there is an increasing demand that this theory be held in abeyance until it can be proved by instrumental means. That the fall in pressure referred to on page 171, this journal, for August, was the latter sudden fall and not the other, any one can see by reading that page. When I alluded to the observed rise of pressure in a tornado I had in mind three remarkable instances given by Prof. Ferrel, on page 94, Meteorological Researches, for the use of the coast pilot, Part II, as follows: "In a tornado at New Harmony, Ind., April 30, 1852, the rise of the barometer for a short time was nearly one-tenth of an inch, and this was accompanied by a great fall of rain and hail." Two very sudden storms of this sort were experienced by the submarine cable expedition in the Persian Gulf, on the 1st and 2nd of Nov., 1869. It is stated that "the barometer remained on both occasions unaffected up to the last moment; but as soon as the storm arrived it rose about two-tenths of an inch, and fell again when it passed over, thus showing that the propelling power was pressure from behind, produced by the weight of the falling rain, or some other cause, and not vacuum in front, as in ordinary storms."

These quotations are very extraordinary, and when we find that nearly the whole of the few previous pages has been printed in "Recent Advances in Meteorology," by Prof. Ferrel, but that these cases have been omitted, our wonder increases. I think, however, that this increase of pressure is proved beyond question by instrumental records in the center of thunder-storms which I have no question develop into tornadoes under favorable conditions. I find distinct references in this journal as follows: 1884, pp. 76 and 109; 1885, pp. 66, 200, 287 and 292. Sprung in his meteorology gives an illustration bearing on this

question. The next annual report of the Chief Signal Officer will contain numerous instances of this phenomenon, prepared in 1884, when the discussion was in its infancy, but seemingly only corroborative now.

It is to be hoped that discussions on this subject will be kept up. The possible theories are becoming narrowed down, and the time may be near when we shall have a much more rational theory of tornado generation than that now in vogue.

September 22, 1887.

H. ALLEN HAZEN.

SELECTIONS.

REDUCTION OF THE BAROMETER TO SEA-LEVEL.

[CONCLUDED.]

Rühlmann's assertions are really based upon the slight amplitude of the "true" air-temperature,—which is frequently quoted as an incontestable truth,—compared with the large amplitude yielded by direct observations, especially the comparison of the magnitude of the daily with the yearly amplitude. But this apparent decrease of the amplitude calculated in comparison with observation is only due to the formula used by Rühlmann. After he reduces it to

$$\text{I.} \qquad h = z\,(1 + a\,t)\,\log\frac{\mathrm{B}}{b},$$

and hence deduces the equation

$$\text{II.} \qquad t = \frac{1}{a}\left\{\frac{h}{z\log\dfrac{\mathrm{B}}{b}} - 1\right\}$$

where t is the temperature, h the height above sea, z the barometer constant, a the coefficient of air, B and b the air-pressure of the lower and upper station respectively.

Before deducing from this incomplete equation daily and annual periods of temperature, Rühlmann should first have seen if the humidity had not a considerable influence, and he would have found that for July, the mean for 2 hrs. with the humidity

of 100 per cent., gives a true temperature of 11.4°, and a humidity of 0 per cent., gives 13.7°.

The humidity therefore cannot be neglected.

When we consider these circumstances we cannot avoid greatly doubting Rühlmann's true temperature, and must seek other causes for the non-agreement between the barometric heights and those obtained by levelling, or what is the same thing, for the exactitude of the reduction to sea-level.

What makes the reduction unreliable is that the decrease of temperature with height has not yet been sufficiently investigated. The calculations hitherto carried out give different values for each mountain, for each side of a mountain, for each position, for each month, for each hour of the day, and even for each condition of weather.

What we have just said about temperature holds good for humidity also, the vertical decrease of which is just as little known, and therefore this as well as the decrease of temperature must be thoroughly investigated.

The *deviations due to local attraction* are also in most cases unknown, but its influence on the reduction is so small, that it vanishes by the side of the errors caused by temperature and humidity. The *height above sea* is often very doubtful, although it may have been determined by levelling. The levelling has been carried out with observations instituted for other objects, as *e. g.*, for railroads, and these are not above all objection.

Lastly, we have to consider the *air-pressure.* Groundless objection has often been raised against Laplace's formula for heights, that it presupposes a statical condition of the atmosphere, while in reality the condition is dynamical. It may be stated against this objection that Laplace by no means presupposes a state of equilibrium of the atmosphere, but he has only put the vertical component of the movement of a particle of air equal to zero, while as regards the horizontal component he has neither made any assumption nor had any necessity to do so. Rühlmann has not used the horizontal component at all in his work, but has made the remark, wrongly as it appears to us, that

"the state of atmospheric equilibrium" is presupposed in the deduction of the formula.

The supposition only refers to the vertical components, and is justified by the fact that the atmosphere really has a tendency to restore its equilibrium when disturbed.

As perfect equilibrium cannot exist in the vertical direction, we have to show how great is the influence of this disturbance, in which way it exerts itself, and how far it depends upon daily and yearly periods. Isolated elevated stations are most suitable for this purpose, if they lie in the region of cyclone paths or of anti-cyclones. We should have to expects large amounts, if a cyclone is forced to traverse a mountain chain, say 5,000 metres high, and great disturbances of the surfaces of level must occur.

On the basis of the above remarks, which will be eventually published separately in a more detailed form, we beg to make the following proposals to the International Meteorological Committee as a preparation for a future Meteorological Congress:

(1) The subject of the reduction to sea-level should be declared not yet ready for decision, as at present neither the formula for the calculation of international tables for the reduction of air-pressure to sea-level can be accepted, nor can a process of reduction be settled.

(2) It would be consequently necessary to invite meteorologists to submit to a critical examination the deduction of Laplace's formula for heights, or the formulæ of Bauernfeind and Rühlmann to alter the constants according to the most recent determinations, and to modify the formula for the reduction to sea-level in such a way that an accurate calculation without the use of logarithms may, with the use of tables, be effected, and in which all variables, such as height above sea, air-pressure, temperature, humidity, and geographical latitude are duly taken into account.

(3) To request meteorologists to make the vertical distribution of humidity and temperature the subject of thorough and comprehensive investigations; to study these elements, especially

in different conditions of weather, and in different parts of cyclones and anti-cyclones.

(4) To invite these meteorologists who have the opportunity, to deal with synoptic meteorology, to investigate pressure observations of very elevated stations, that have been reduced to sea-level at times of great atmospheric disturbances, with a view of indicating possible influences of vertical movements of the atmosphere upon the reduction of pressure to sea-level.

(5) To request editors of meteorological journals to turn their attention to the questions referred to in these proposals, until the meeting of the next Meteorological Congress, by furnishing their readers with detailed reports and reviews of contributions bearing upon the subject."

The following is the paper of the Duetsche Seewarte:

"It may be first stated that the historical introduction of the letter of the Chief Signal Officer contains some mis-statements, as the "isobarometric lines" of Kämtz have no connection with the "isabnormal lines" of the Americans. The former are lines of equal mean monthly variations of the barometer, and the latter are lines of equal deviation (from the normal), of the reading of the barometer for a given moment of time, or for a given month (Dove's "isametral" lines). And the latter method was not generally abandoned in 1857, but, in Russia and Austria, was only given up subsequently to the Vienna Congress of 1873.

The proposal to take as a basis for the calculation of the air-temperature to be used in the reduction the mean of the last three observations, appears to have no prospect of being generally accepted, for the following reasons:

(1) The investigations of Rühlmann and others show that the daily oscillation of the temperature of the free air is only less than that at the earth's surface, but that it is not to be neglected, for the variation of the daily period of air-pressure with height, on isolated mountains, is pretty accurately explained by the daily variations of temperature in the free atmosphere. The difference between the mean values at a station and in the free atmosphere is, according to Rühlmann, nearly the same as that of the extreme hours and extreme months, so that the daily means do

not generally give the most accurate reduction, but in the coldest month the warmest hour, and in the warmest month the coldest hour (or the nearest to it).

(2) The anomalies and incongruities between neighboring stations of different heights which occur in the reduction to sea-level, are by no means restricted to the daily period, but depend on other causes as might be seen in Europe where, until recently, the morning observations only could be compared with each other. The first difficulty occurred at the time of the adoption of the method in Austria in 1874, during the winter ot Hermannstadt, which being situated in an elevated valley, showed abnormally low temperatures on 1st–9th January; these, when used in the reduction, plainly give too high a value for the pressure at the sea-level. so that Hann proposed (*Zeitschrift der Oesterr. Gesellschaft*, 1874, p. 1 *et seq.*) to carry out, at all stations above 100 metres, the reduction by means of the normal monthly mean temperature.

Hann's proposal goes still somewhat farther, as he would also disregard the influence of the variation of pressure on the reduction, and proposes a constant reduction for each month, only clothed in another form. (He would apply, for instance, at such stations the existing deviation from the normal, without a proportional increase in the normal readings reduced to sea-level.)

(3) The supposed introduced retardation of the non-periodical variation of temperature by the proposed method causes the results to be affected with a systematical error, which is the greater since in fact variations of temperature of this kind occur more rapidly in the free atmosphere, or in the higher strata than at the surface of the earth, as the irregularities of the latter prevent the rapid renovation of the masses of air, and the proximity of land or water changes the temperature of the fresh masses of air which are approaching and assimilates them to that of the air which has preceded them. We must make a careful distinction in this respect between the changes of temperature caused by radiation and by transport of air. In the former case, which especially influences the daily period, the nature of the fixed base is the most active element; in the latter case every body which

does not change its place with the air operates in an obstructive manner.

(4) Finally, we must take into consideration against the proposal the serious fact that the values so reduced are not, as is the case with the method employed at the Seewarte, available for more accurate discussion by the application of further corrections, but that such a conversion would be so troublesome and uncertain that a complete recalculation of the original values would be preferable.

General Considerations.—Every person reducing meteorological observations taken at the surface of the earth to an ideal lower level finds himself in this difficulty; it is impossible to put the problem simply. For at the place, to which we wish to transpose the barometer reading or air-temperature by reduction, no air exists, but if we sink a shaft to the required depth, the temperature of the air in the shaft, and therefore also its pressure, are altogether different owing to the influence of the solid surrounding from that which we wish to assume as a basis for the reduction. But in the case of the reduction to a higher level, circumstances are more favorable, for here we take into the calculation the air-pressure or temperature which probably actually prevails there.

If, for various reasons, we cannot adopt the introduction of a reduction to a higher instead of a lower level, then, as here what we aim at is not real, the object must be decisive in the choice of the method.

The principal object of the reduction to sea-level is to obtain for the air currents at the surface of the earth a picture representing the distribution of air-pressure, such as especially an isobaric chart. We require, therefore, for an uneven country, something strictly speaking, impossible, as the horizontal distribution of air-pressure, when horizontal differences of temperature exist, differs with each level. We must here consider different cases of as simple a character as possible.

1. *Plateaus.*—Given a tableland with a number of stations at the same level with different air temperatures. Here the reduction with regard to the existing temperature will give a distribu-

tion of pressure for the ideal sea-level, which differs from that of the tableland itself, and a fictitious difference of pressure results from the reduction between two stations of the same height, and in reality having the same pressure, as colder stations always get a higher pressure than the warmer station. The amount of this fictitious difference of pressure, when the lower pressure is not far from 750 mm., is given by the equation:

$$B - B^1 = 24h \frac{T^1 - T}{T\,T^1}$$

where T is the temperature measured from -256°. If, *e. g.*, T = 270, and T^1 = 280, then between the two stations, Bayreuth and Ratisbon, which are equally high, viz., 359 metres above sea-level, we get a fictitious difference of pressure of 1.1 mm. by the reduction, if the pressures are the same at both stations. In reality there was not only no such gradient in the atmosphere at the surface of the earth between Bayreuth and Ratisbon, but even, as the country between both places is somewhat higher, there would be a small gradient in the opposite way, from the warmer to the colder place. For the determination of the distribution of pressure and of the air-currents on an horizontal plateau, if (for casual comparison with low lands) a reduction to sea-level is to be affected at all, an identical correction for the whole area would be preferable.

2. *Declivities.*—In the case of an inclined plane between two stations, a consideration of the question shows that an approximate knowledge of the distribution of pressure at one point of the line of junction (with reference to this line) would be best gained by reducing the upper station downwards, and the lower station upwards, to the level of this point, taking the observed temperature of both stations and the probable vertical decrease of temperature in this district, or over the lower station, as a basis for the reduction.*

3. *Stations in Valleys.*—If the district between the stations is higher than the stations themselves, then, as before stated, in

* M Léon Teisserenc de Bort first proposed to the International Committee at Copenhagen in 1882 to calculate the gradients on declivities by a very similar method. (See App. VII. of that Report.)

deducing the distribution of air-pressure and the conditions of the wind, the reduction should be made upwards on both sides, by which means the differences of temperature have an opposite influence to that which they have in the reduction downwards.

From these considerations it follows:

(*a*) The consideration of the horizontal differences of temperature in the reduction to a uniform level is only of advantage so far as the distribution of pressure in this selected level is of actual interest; the latter is not the case for the fictitious distribution of air-pressure at the sea-level under tablelands, but it is so in all reductions to a mean or higher level. The consideration of the horizontal differences of temperature, therefore, recommends itself for the portion of the height which lies between the stations, but not for that which is common to all or most of the stations of the area in question, or which lies below the selected mean level of the latter.

(*b*) In order to gain an iusight into the main features of the atmospheric pressure over the globe, we can make the air-pressure of mountainous countries and tablelands, reduced to a selected mean level, comparable to that at the sea-level, by the addition of a proper number of millimetres, which is uniform for the former level, so far as the nature of the case will allow this to be done. Hann very properly proposes to use the normal monthly means of temperature as a basis for the reduction to this temperature.

For this an average value is to be chosen according to the conditions of that tableland, for the reduction of the level in question to that of the sea-level, with which value the comparison should be made by preference, with the addition of the mean decrease of temperature as far as half the height of the level. For a useful application of this reduction it is presupposed that the height above the sea of that mean level is not so great as to cause the horizontal distribution of pressure at the corresponding level above the adjacent lowlands, or the sea, to be essentially different from that which is represented on the synoptic charts for the level of the sea. As the non-periodic variations and the differences dependent upon locality amount in all zones

to about as many millimetres in air-pressure as centigrade degrees in temperature, the upper limit should be taken at a height in which a lower difference of air-pressure of 1 mm. is equalized by a mean difference of temperature of 1° C. in the column of air, and this is the case at 2,500 to 3,000 metres, a level below which more than one quarter of the atmosphere lies.

(*c*) In the weather reports of the Seewarte the foregoing views are applicable in the following manner:

If we adopt 300 metres above the sea as the mean level for south and central Germany, the mean temperature in this stratum, or the temperature at a height of 150 metres is as follows:

—	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept	Oct.	Nov.	Dec.
Assuming a decrease of temperature per 100 metres - - - -	0.3	0.5	0.66	0.66	0.7	0.8	0.7	0.7	0.6	0.5	0.5	0.3
According to Leipsig (119 metres) -	—1.3	0.7	3.0	8.1	12.8	16.0	17.8	17.3	13.7	8.8	2.9	—0.1
" to Münster (63 metres) -	0.9	2.4	3.7	8.1	11.9	15.4	16.9	16.4	13.9	9.8	4.2	2.1
" to Wiesbaden (111 metres	—0.5	2.2	3.9	9.2	13.4	16.6	18.4	17.5	14.0	9.2	3.9	0.6
" to Carlsruhe (123 metres)	0.7	2.6	5.4	10.6	14.7	18.0	19.7	19.0	15.6	10.4	5.0	1.6
" to Bamberg (236 metres)	1.0	1.3	4.7	9.4	14.6	17.6	18.8	18.6	15.0	9.4	4.5	0.1
Mean - - - - - - - -	0.4	1.8	4.1	9.1	13.5	16.7	18.3	17.8	14.4	9.5	4.1	0.9
Corresponding to a reduction to sea-level* - - - - -	27.9	27.7	27.5	27.0	26.6	26.2	26.1	26.1	26.3	26.9	27.5	27.8

*Assuming a lower barometer reading = 760 mm., according to the formula:

$$2.8808 - \log b = \frac{300}{18400 + 72t}.$$

The advantage of using the normal temperature for the different months is, however, not very great; for, as in Germany, the extremes of temperature in each month differ as much from each other, at least on an average, as the mean temperatures of the warmest and coldest months, so that the maximum temperature in January and the minimum temperature in July are pretty nearly the yearly mean. As these two extremes generally occur in cloudy weather, the daily period has no great influence upon them. We can estimate that in the extreme months the actual temperature lies nearer to the yearly mean in about one-sixth of the cases than to the normal monthly mean. For the weather reports of the Seewarte, in which the coast stations play a prin-

cipal part, the conditions below 150 metres above the sea have such a paramount importance, that it is desirable to retain the direct reduction to the sea-level which is now employed, with the yearly mean temperature, for all stations below the specified mean level of 300 metres, in order in this lower level to avail oneself of the practical advantages of this method as given some time since by the Seewarte, and especially to prevent a complete break in the transition from one level to another, which would not be possible in the proposed partial reduction upwards.

Up to this height the differences occurring in the reduced values, by taking into consideration the temperature with the monthly mean, do not in fact amount to 1 mm., while with the extreme individual temperatures they certainly amount to 2 mm. For the two German stations in the weather reports, which are situated above this level, Munich and Friedrichshafen, these deviations, on the contrary, reach 4 to 5 mm., and even more, so that they may cause an essential distortion of the isobars, and even an inversion of the gradients. It is to be recommended in reducing the barometer readings of these stations in the Weather Reports for the stratum above the adopted limit of 300 metres, to take the existing temperature into consideration, by applying the corrections (which have only been calculated provisionally):

t =	−20°	−15°	−10°	−5°	0°	+5°	+10°	+15°	+20°	+25°	+30°
Munich	+2.2	+1.8	+1.5	+1.1	+0.7	+0.3	−0.1	−0.5	−0.9	−1.2	−1.6
Friedrichshafen	+1.0	+0.8	+0.6	+0.5	+0.3	+0.1	0	−0.2	−0.4	−0.6	−0.7

As for t is to be taken the probable temperature half way between the stations and 300 metres, we have, generally, to add to the station-temperature for Munich $0.58° \times 1.25 = 0.7$ and for Friedrichshafen $0.58 \times 0.53 = 0.3$. This correction may be neglected, and the temperature at the station be simply taken.

(*d*) Although the mean altitude of the large tablelands in the west of the United States is only about half of the above-named height of 2,500 to 3,000 metres, it is still doubtful whether for these plateaus, especially so far as they are separated from the lower countries by high mountains, the approximate reduction to sea-level is suitable, and whether it would not be better to draw double isobars; for the sea-level, and for an upper level,

e. g., 1,500 metres = 5,000 feet respectively, over the lowlands both, and for the upper level solely over the highlands? Such a system would undoubtedly prove very useful for study and for the purpose of forecasting.

(*e*) The daily period of temperature should properly speaking not be excluded, but, like all other (periodical and non-periodical) effects of radiation, should be lessened. But as the measure of this diminution must in most cases be arbitrary, its exclusion may be of advantage. If this is the case, it should certainly not be done by the one-sided compensation of the variations of temperature as has been proposed; but by applying its normal amount to the reading, that is, by the reduction of the latter to the daily mean."

TIERRA DEL FUEGO.*

There are few parts of the habitable globe about which so little is definitely known as "Tierra del Fuego," that vast archipelago which forms the southern extremity of the continent of South America. Since the great navigator Magellan in 1520 discovered and passed through the straits which bear his name and which separate it from Patagonia, down almost to the present time, it has been a land of mystery and uncertainty, a *terra incognita*. Even the name by which it is known is a misnomer, for though it is called "the land of fire," it is rather a land of frost. It received its appellation of "Fireland" from the simple circumstance that when Magellan passed its northern coasts, every night his attention was attracted by small fires along and through the innumerable channels which he supposed in some mysterious way appertained to the country, whereas they were lighted by the inhabitants as signals, or to assist them in their nocturnal fishing operations. During the three hundred and fifty years which have elapsed since its discovery, owing to the rough seas and persistent winds which for a large portion of the year prevail along its shores, sailing vessels doubling Cape Horn have given it a wide berth; while the passage through the straits,

* Report by Consul E. L. Baker, U. S. Consular Reports, No. 83, Sept., 1887.

owing to currents and devious channels, is only practicable for steamers, and these have only been taking that route within the last few years.

For these reasons the history of Tierra del Fuego, or "Fireland," is soon told. Indeed, what was supposed to be known in regard to it was so mixed up with strange and extraordinary stories and fictions, owing to the fertile imaginations which travelers sometimes possess, that it was difficult to tell what to believe. Cannibals, curiously shaped beasts of prey, and strange amphibious animals were once everywhere to be found there; but they have all disappeared with the additional knowledge which we now possess of that country; and it has at last quite emerged from that mysterious, fantastic condition in which for all these centuries it has reposed.

Very few of the early navigators did more than sail along its shores, touching here and there for a few days, and occasionally having a glimpse of the inhabitants. In 1525 Garcia de Laiza repeated the voyage of Magellan through the straits, but died during the passage. In 1534 Simon de Alcazaba undertook the same route, but he was killed by his mariners in revolt, all of whom afterwards miserably perished. Then, in 1539, followed the expedition of Alonzo de Camargo, who succeeded in making the first direct passage from Spain to Chili. In 1577 the English navigator Drake also sailed through the straits, making the entire passage in seventeen days.

The same year the viceroy of Peru sent Captain Pedro Sarmiento de Gamboa with orders to examine the straits in detail, and he reported the perfect fitness of the country for the location of a colony. His report was approved by the King of Spain, who named Sarmiento captain-general of all the country south of the Straits of Magellan. Sarmiento left Seville on the 25th of September, 1581, with twenty-three sail, carrying soldiers and colonists and a full outfit for the proposed colony. Everything, unfortunately, conspired against the expedition. A number of the ships were lost in a tempest; then insubordination ensued on board the fleet. He finally reached the straits, but a continuation of contrary winds prevented him from reaching or find-

ing the locality which he had previously selected for the colony. He returned to Rio Janeiro to recruit and replenish his stores, after which he again set sail for Tierra del Fuego. Still further mishaps, however, were in store for him, and by the time he reached the straits he had only two ships, carrying two hundred and eighty colonists and a few soldiers. He finally managed to reach a point on the peninsula of Brunswick, where he concluded to establish his colony, to which he gave the name of Jesus; but for greater security, and the better to guard against the attacks of the Indians, he founded a second settlement further down the coast under the name of Ville de Saint Philippe. The two places, under the energetic measures which he adopted, made a very promising beginning. But during one of his voyages to Rio Janeiro after supplies he was captured by Captain Drake of the English navy and taken to England, where he was subsequently set at liberty by Queen Elizabeth. During his absence the unfortunate colonists ran short of the necessaries of life, and a great number of them miserably perished by famine. In 1586 Sir Thomas Cavendish penetrated the straits and touched at Saint Philippe, where he found a few of the colonists still alive but suffering the greatest distress. He consented to take them on board, but he was unwilling to hunt up those who had wandered into the forests or remained at the other settlement.* He very appropriately gave to the locality the name of Port Famine, which it has retained ever since.

After this a number of voyagers visited the straits in succession, among them Merrick, in 1589; Chidley, in 1591; Hawkins, in 1593; Oliver Van Noort, in 1598;† Siebold de Wort, in 1599, and Joris Spilbergen, in 1614; but they added nothing of consequence to the stock of information in regard to Tierra del Fuego.

In 1615 the French navigator Le Maire first passed through the strait which separates Tierra del Fuego from States Island,

* Burney, in his "History of the Buccaneers," says Cavendish found twelve men and three women, but that he refused to aid them, and that subsequently, in retaliation for such cruelty the Spaniards in Chili hanged a number of his men. In the present age one would suppose that he was the proper man to hang.

†At Port Famine, Captain Merrick picked up a Spaniard, the last remaining survivor of Sarmiento's colony, who gave a fearful account of the sufferings he had undergone. He, as well as Captain Merrick, died on the passage home.

a strait which still bears his name, and discovered Cape Horn, which he was the first to double. About the same time Philip III, of Spain, commissioned the brothers Nodal to make a general reconnaissance and survey of all the coasts at the southern extremity of South America; and it is a remarkable fact that during the time it took to make these surveys those navigators did not lose a single man.

In 1695 the French Government fitted out an expedition with a view to selecting ports of refuge for their vessels on the South American coast, Captain De Gennes making the first reconnaissance. In 1698 a French company was formed for establishing colonies in the various parts of South America, and to that end Captain Beauchesnes-Gouin for two years explored the straits and the archipelago. He took possession of the principal island and called it Louis the Great. These attempts at occupation, however, were not followed up, and immediately after the accession of the Bourbon dynasty to the Spanish throne, the French Government, through fear of wounding Spanish susceptibilities, desisted from its project.

There were no further explorations until 1763, when the English mariners, Byron and Carteret, made their famous voyages around the world. Both passed through the straits and touched at Tierra del Fuego, and in their reports rectified many errors in regard to that country which had previously been published. Byron visited the remains of the Sarmiento colony, and says he "could not understand why so delightful a spot should be called Port Famine." He further says: "Flowers, trees, and birds delight the traveler; fish abound in the waters; while lofty mountains form a magnificent background to the picture." Repassing the straits he fell in with a number of Fuegian Indians, to whom he gave biscuit and clothing, and "a woman of fair skin was pointed out to him by the rest, as if to express that she was of English origin, being perhaps the wife of some sailor or colonist cast away on those shores."

The next effort to settle Tierra del Fuego was in 1767, when Bucareli, the Spanish governor of Buenos Ayres, charged with the duty of reoccupying the Falkland Islands, which France

had ceded to Spain, undertook to establish a colony on one of the islands of Tierra del Fuego, situated in latitude 54° 40′. The locality seemed to be very suitable, and the natives peacefully watched, and even assisted, the colonists in their labors; but the location was so remote from civilization, and it seemed so like a place of exile rather than of promise, that the settlement attained to scarcely any development, and it was finally abandoned. The same year Captain Samuel Wallis visited the country, and brought back the most unfavorable reports in regard to it. He said "it was a savage region, where, even in mid-summer, the climate was cloudy, cold, and tempestuous; where the valleys were without verdure and the mountains without trees;" and where, indeed, "the whole land seems like the immense ruin of a former world." Admiral Anson, who also skimmed along its shores, pronounced it "the most horrible country which it was possible to conceive." Captain Cook, the famous navigator, who lost two of his naturalists in their attempts to climb one of the mountain peaks on the western coast, says: "It is the most savage country I have seen. It seems entirely covered with mountains and rocks, without the least appearance of vegetation, the mountains terminating in horrible precipices or rugged peaks reaching to an immense height. There is no place in the world which offers such desolate landscapes." King, Wyse, and Cunningham, in their reports, have painted the country in almost equally somber colors. The first affirms, however, that "the vegetation is magnificent in some places, and under the shelter of the great forests some plants are found which would be considered very delicate in England;" while Wyse speaks of the "dense forests, with trees which retain their leaves the whole year," and "of the magnificent landscapes, now smiling, now severe, which offer themselves to those who navigate the coasts of Admiralty Sound."

The most important expedition, in a scientific point of view, which ever was sent to Tierra del Fuego, was that of Captain King, of the British navy, who in 1826, with two vessels, the Adventurer and the Beagle, was commissioned to make surveys and charts of the coast of South America, from the River Plate to

Cape Horn. Captain Stokes was at first in command of the Beagle, but upon his death in 1828, Captain Fitzroy took his place and devoted four years to the work, making a full exploration of the devious and dangerous channels of the straits. The expedition returned to England in 1830, and the surveys were published in 1832. Captain Fitzroy brought home with him four Fuegian Indians, and placed them at school at Walthamston. They were known as "York Minster," aged 26 years; "Boat Memory," aged 20 years; "Jimmy Button," aged 14 years, and "Miss Baskett," aged 9 years. The second, who was the most docile and the cleverest of the party, died of small-pox at Plymouth Hospital, and was much regretted. They had all been seized as reprisals for a boat belonging to the ship which had been stolen by their people; and Captain Fitzroy promised to bring them back to Tierra del Fuego. King William IV and the Queen took much interest in them and their education, but Captain Fitzroy was unable to prevail on the Government to fit out another expedition. He thereupon chartered the brig John, of London, to carry himself and four others back to Tierra del Fuego. The Admiralty, on learning this, finally changed its decision and gave him again his old vessel, the Beagle, to carry out his great project of completing a chain of meridian distances around the earth. As he was desirous also of making botanical and geological observations, he had the good fortune to prevail on Mr. Charles Darwin, a young man who had already shown great talent, and who afterwards became the distinguished scientist, to accompany him on the expedition. On the 15th of December, 1832, the Beagle sighted Cape San Sebastian, and some painted Indians wearing skins were seen running along the shore. "York Minster" and "Jemmy Button" wanted Captain Fitzroy to fire at them, saying that they were bad men. Fitzroy here tells us of the reflection which forced itself upon his mind, that when Cæsar came to Great Britain he found Fitzroy's ancestors dressed in skins and painted like those Fuegians. The Beagle came to anchor in the Bay of Good Success, when "Minster," "Button," and "Miss Basket" were restored to their friends. "I was flattered," says Captain Fitzroy, "at

the thought that many a poor shipwrecked seaman might find friends and protectors in the Fuegians whom I had educated in England." Two years were spent in additional surveys of the coast. His labors there and elsewhere, extending over nine years, were considered of such value that the Royal Geographical Society conferred upon him its gold medal "for the first chain of meridional distances around the earth and complete surveys from the River Plate to Guayaquil." His sailing charts for the Straits of Magellan and the various channels connected therewith are still in use by sailing masters.

Mr. Darwin's part of the expedition is no less memorable and well known. The zoology of the voyage of the Beagle includes an account of the fossil mammalia, by Professor Owen; of the living mammalia, by Mr. Waterhouse; of the birds, by Mr. Gould; of the fish, by Mr. Jenyns; and of the reptiles, by Mr. Bell; Mr. Darwin appending to the descriptions of each species an account of its habits and range. Besides this, Mr. Darwin published separate works, entitled "Researches into the Natural History and Geology of Countries Visited during a Voyage Around the World," "Geological Observations on South America," "Volcanic Islands," etc. The first-named work, intended for the general reader, gives some admirable chapters in regard to the Argentine Republic, and especially Patagonia. Those in regard to Tierra del Fuego, however, have a special interest, from the fact that they furnish us the first important information we have of an authentic or reliable character in regard to the physical peculiarities of the southern extremity of South America. It is evident, however, that he failed to obtain a very intimate acquaintance with the interior of Tierra del Fuego or its physical conditions. At any rate, his estimate of the country is unfavorable to the extent of being unjust and untrue. He says:

> Tierra del Fuego may be described as a mountainous land, partly submerged in the sea, so that deep inlets and bays occupy the place where the valleys should exist. The mountain sides, except on the exposed western coast, are covered from the water's edge upward by one great forest. The trees reach to an elevation of between 1,000 and 1,500 feet, and are succeeded by a band of peat with minute alpine plants; and this

again is succeeded by the line of perpetual snow, which, according to Captain King, in the Straits of Magellan, descends to between 3,000 and 4,000 feet. *To find an acre of level land in any part of the country is most rare!*

To correct some of the gross inaccuracies and absurd blunders which have thus, during all these years, been furnished to the world, five years ago Lieutenant Bové, of the French navy, by permission of the Argentine Government, and partly under its patronage, made an expedition to the southeastern portion of Tierra del Fuego, and the result of his labors was a report of great value on the fauna, flora, and general characteristics of the country and the condition and language of the people. A still more recent and much more valuable contribution to our stock of knowledge in regard to that region has been furnished by the Rev. Thomas Brydges, who, as a missionary of the Church of England, has resided in the southern portion of Tierra del Fuego for over twenty-five years, and where, with his wife and children, he has devoted himself to the work of diffusing civilization and Christianity among the inhabitants. During his long missionary labors Mr. Brydges has become thoroughly identified with the country and with the singular people who occupy it, and has accumulated a large amount of interesting information in regard to both. He has recently been on a visit to Buenos Ayres, with a view to obtaining from the Argentine Government certain concessions, whereby to increase his usefulness as a missionary and to assist him in his efforts to develop the resources of that country. While in Buenos Ayres, he delivered an address on the results of his observations and explorations,* which has added very much to the sum total of exact and authentic information in regard to Tierra del Fuego. Besides this, Don Ramon Lista, a well known explorer and a memmember of the Geographical Society of Buenos Ayres, has just returned from an expedition, scientific and geographical, fitted out under the direction of the Government to that part of the island which forms the eastern and southeastern coasts of Tierra del Fuego, and has brought back a large addition to the general

* Reported for and published in *La Nacion* of Buenos Ayres.

knowledge on those subjects. Mr. Julius Popper, a man of scientific antecedents, has likewise just completed, in the interest of a mining company, an exploration entirely across the country from Useless Bay, on the west side, to San Sebastian Bay, on the east, and thence along the coast. From all these sources I have collected many facts and discoveries which refute and correct the errors and blunders of former explorers, and which may be of interest to the people of the United States.

I may premise, that on all the old charts and maps Tierra del Fuego is put down as belonging to the Argentine Republic. Subsequent to these, however, Chili set up a claim to the ownership, and insisted that the entire archipelago was a part of her territorial possessions. It would appear that the Argentine Republic had the best *paper* title, inasmuch as the boundaries of Chili, as set forth in her constitution, do not cover any territory east of the ridge of the Andes, or south of the Straits of Magellan; yet, while the Argentine Republic quietly rested its case on its ancient documents and records, Chili, more enterprising or more in earnest in the matter, proceeded to take actual possession of the territory in dispute by planting colonies at Sandy Point (Punta Arena) and other places on the north side of the straits; by erecting beacons and other helps to navigation along the shores, and by establishing a government and placing a governor in charge of the country. Indeed, by gradual encroachments, Chili finally set up a claim, not only to all of Tierra del Fuego but to a large part of Patagonia fronting on the Atlantic; and at last actually went so far as to seize merchant vessels loading guano under permits of the Argentine Government, at the Santa Cruz River, 200 miles north of the straits. This awakened the Argentine Republic to a realizing sense of the situation; and at once a war of diplomatic notes ensued, followed by ministers asking for their passports, and a rupture of the friendly relations between the two nations. A war seemed imminent; indeed, the disputing parties were on the verge of hostilities, when, through the friendly interposition and kindly offices of the United States representatives at Buenos Ayres and Santiago, a treaty of limits, all the terms of which were agreed

to by telegraph, was ratified, thus saving the two countries from a desolating war. This treaty was signed on the 23d of October, 1881; and by its terms the backbone of the Andes is still made the dividing line, north and south, between the two countries to the fifty-second degree of latitude; thence, however, the line is made to run almost due east to Cape Virgin, on the Atlantic coast; and then due south through Tierra del Fuego, parallel with the sixty-eighth degree of longitude. So that, for the sake of peace, Chili has obtained the lion's share of the division, securing not only a large lateral slice off of Southern Patagonia, but a very large proportion of the islands of Tierra del Fuego. Only the tongue of that archipelago, running to the eastward and including States Island, now belongs to the Argentine Republic. Cape Horn itself is now the southern extremity of Chili. By the terms of the treaty, the Straits of Magellan are neutralized and free to the navigation of all flags; but Chili still asserts and exerts her sovereignty over them.

The group of islands forming the archipelago of Tierra del Fuego lies between latitude 52° 40′ and 56° south and longitude 63° 40′ and 75° west. The largest of these islands is generally known as Tierra del Fuego, though it has been heretofore called "King Charles South Land," and the natives themselves call it "Onisin," or the land of the Onas, the name of the inhabitants. The next largest islands are called Navarino, Horte, Clarence, Gordon, Wallaston, and States Islands, besides which there is an immense number of small ones scattered through the western channels, some of them consisting merely of rocky peaks projecting out of the water. The mountainous line of the coast along the principal island is cut at frequent intervals by the sea, thus forming countless peninsulas and inlets.

Tierra del Fuego from Cape Pilar, on the west side of the group, to Cape San Diego, on the east, has a width of 352 miles; and from Anegada, on the north, to Cape Horn, on the south, it has a length of 228 miles. Thus the size of the archipelago may be put down as upwards of 80,000 square miles; about as large as the State of Kansas.

The aspect of the country, instead of being a mountain of eternal snow, as Darwin says, is exceedingly varied, presenting almost every diversity of surface, elevated mountains, deep valleys, rolling table lands, fertile plains, numerous lakes, and frequent water-courses.* Occupying a large portion of the extreme north, and extending from one extremity to the other of the straits, are continuous chains of mountains, sometimes running into peaks several thousand feet in height. These ranges of mountains, as yet, form quite an impassable barrier by land between the northern and southern portions of the country, since their tops are not only covered with snow throughout the year, but along their sides they present a continuation of forests so dense as to be impenetrable. I suppose, however, that upon further exploration passes will be found which can be made practicable. Adjacent to these mountains on the south is a wide belt of elevated and rather barren plain, running the entire width of the island, from Useless Bay on the west to the northern part of San Sebastian Bay on the east. Then succeed elevated table lands, quite covered with forests. South of this is another chain of sierras, running from the lower part of San Sebastian Bay, almost through the center, in a southwesterly direction to Admiralty Bay. Then, to the south, the country opens into an extended plain or pampa, which occupies all the central portion of the island, and which is quite destitute of trees, except small patches here and there of hardwood and shrubs. It is covered with an abundance of rich grasses, which, in some parts, are

* Ramon Lista describes the island as follows: "This great southern island has been called sterile, and even uninhabitable, through an error consecrated by time This may, to some extent, be true in reference to that part of it now belonging to Chili, but it is false and ridiculous as to that portion which lies along the Atlantic and belongs to the Argentine Republic. Those who suppose that the eastern part is a range of mountains covered with eternal snows and inaccessible from the ocean are greatly mistaken. Argentine Tierra del Fuego presents two aspects: From Cape Holy Ghost to Cape Peños there are valleys more or less extensive, covered with splendid groves and irrigated by large rivers, some of them navigable. This region enjoys an agreeable temperature, with very little snow during the winter. South of this the appearance of the country changes, and extended forests appear, where the grass is not so abundant nor the rivers so large. The face of the country here is something like that of Switzerland, with small lakes, elevated mountains, and valuable timber forests. On the plains there will yet be planted a great pastoral industry; while I believe the mountains will be found to contain valuable mineral deposits."

very luxuriant and well suited for both cattle and sheep, especially the former. The extreme southern portion, again, from Cape San Diego on the east to Brecknock Head on the west is mountainous—sometimes quite Andine in appearance, some of the peaks being volcanic—with numerous glaciers and dense forests. In many places the glaciers extend from the higher valleys to the sea, breaking into immense masses, which, moving down the sides, are projected in most fantastic shapes upon each other below. Beyond these, on the west, are Mount Sarmiento and Mount Darwin, which run up to a height of 7,000 feet above the level of the sea.

The geological formation of Tierra del Fuego quite corresponds to that of Patagonia. The mountains, broken and disjointed by the convulsions of nature, with wide seas now running where they have been depressed, are but the continuation and southern extremity of the Andes; while the plains and uplands partake of the same geological characteristics as those which distinguish the Patagonian steppes. In some parts the formation is decidedly volcanic. This is especially the case in the islands of London and Clarence. In the island of Picton and in parts of Onisin pumice stone is found in large quantities. In the island of Packsaddle there are several remarkable basaltic hills, and this formation is frequent in the Straits of Ponsonby and other localities. Other igneous rocks everywhere crop out of the mountain sides. Granite is very prevalent and quartz abounds. No limestone has yet been found in the country. Iron also seems to be wanting. Some specimens of lead have been exhibited. It is said that coal has been discovered in Slogget's Bay and Cape Holy Ghost; but from the best information I have, the latter formation is merely lignite. In Valentine Bay, as also in Slogget's Bay, there is a black ferruginous sand of a brilliant color, which may indicate the existence of gold in those places. While no gold has yet been discovered in the southern portions of the country, the precious metal has been found in considerable quantities in various places in the northern.

[TO BE CONTINUED.]